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Humboldt Bay National Wildlife Refuge

Humboldt County, California

A Preliminary Description of the Table Bluff Unit Wetland Vegetation, Humboldt Bay National Wildlife Refuge



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INTRODUCTION

Humboldt Bay National Wildlife Refuge (HBNWR) encompasses 3,350 acres of wetlands and dunes distributed among 9 units surrounding Humboldt Bay, California. The Table Bluff Unit, comprising 161 acres, is located at the southeast corner of the Bay (Fig. 1). Former salt marsh on the site was diked around 1914 (Fig. 2) to create pasture. The site was included in the refuge in 1981. Leaky tidegates had created a mosquito nuisance problem, and in the summer of 1984 the dike was breached in two places by the U.S. Fish and Wildlife Service (USFWS) to alleviate the mosquito problem. At that time, HBNWR was a satellite refuge of San Francisco Bay NWR, with no permanent, on-site staff. Pre-breaching data were not collected, and no active management of the site has occurred during the past 20 years. This report documents an assessment of the site conducted in 2003-2004 with the intent of assessing the value of restored wetlands and the condition of dune vegetation on the Unit.

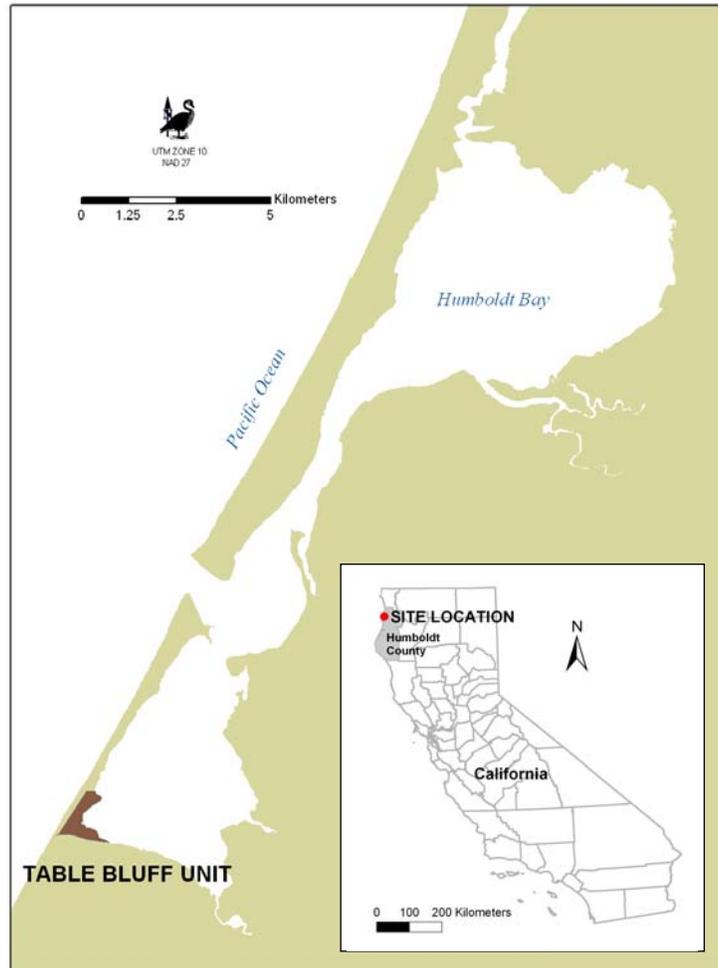


Figure 1: Location of Table Bluff Unit.

METHODS

The site was visited numerous times in the fall of 2003. After a preliminary site reconnaissance, I reviewed aerial photos to delineate potential homogeneous vegetation types. These types were refined in the field, and representative polygons for each type were delineated using a Trimble GeoExplorer 3. Data on vascular plant species were collected for each sample polygon, consisting of ocular estimation of cover by species in the following cover classes: 1-5%, 6-25%, 26-50%, 51-74%, 76-95%, and 95-100%. These cover classes are roughly logarithmic at either end of the scale, representing the importance of species occupying very high or very low cover values. After a sufficient number of polygons were sampled to provide confidence in my ability to delineate them using photo-interpretation, all contiguous wetlands on the site were mapped using heads-up digitizing in ArcView 3.2a (during the period of this study the GIS software being used was upgraded to ArcGIS 9.0 and later analysis and maps were completed with that program). Non-contiguous dune swales located to the west were not included. The finished map was then subjected to ground

truthing and refinement. In May, 2004 I revisited the site to conduct a survey for the rare salt marsh species Humboldt Bay owl's clover (*Castilleja ambigua* ssp. *humboldtiensis*) and Point Reyes birds-beak (*Cordylanthus maritimus* ssp. *palustris*). I walked the salt marsh in a systematic manner, covering all potential habitat, and also examined habitat to the north consisting of undiked salt marsh in order to calibrate my search image.

RESULTS

Vegetation

Seven wetland vegetation types were characterized and mapped (Table 1). Cordgrass, Salt marsh, and two of the three Brackish marsh subtypes (salt rush and mixed) are estuarine wetlands, subjected to regular or irregular tidal inundation and occurring on primarily organic soils (although there is much intergrading of sand and peat), while Brackish pasture, Brackish marsh (slough sedge), Shrub swale, and Herbaceous swale are palustrine wetlands on primarily sandy dune substrates. A map of the vegetation is shown in Fig. 3. Descriptions of each vegetation type follow, and the types are depicted in Figs. 4-11.

Table 1. Wetland vegetation types found on the Table Bluff Unit. Wetland type follows Cowardin et al. 1979).

Vegetation Type	Wetland Type	Dominant species	Acres
Cordgrass	E2EM1N	<i>Spartina densiflora</i>	5
Salt marsh	E2EM1N	<i>Distichlis spicata</i> , <i>Salicornia virginica</i> , <i>Jaumea carnosa</i>	19
Brackish marsh (mixed)	E2EM1M	<i>Juncus leseurii</i> , <i>Potentilla anserina</i> , <i>Atriplex triangularis</i>	14
Brackish marsh (salt rush)	E2EM1M/PEM1C	<i>Juncus leseurii</i>	4
Brackish marsh (slough sedge)	PEM1C	<i>Carex obnupta</i> , <i>Angelica lucida</i>	6
Brackish pasture	PEM1A	<i>Holcus lanatus</i> , <i>Erecthites glomerata</i>	16
Herbaceous swale	PEM1C	<i>Juncus breweri</i>	5
Shrub swale	PSS1C	<i>Salix hookeriana</i> , <i>Rubus ursinus</i>	14

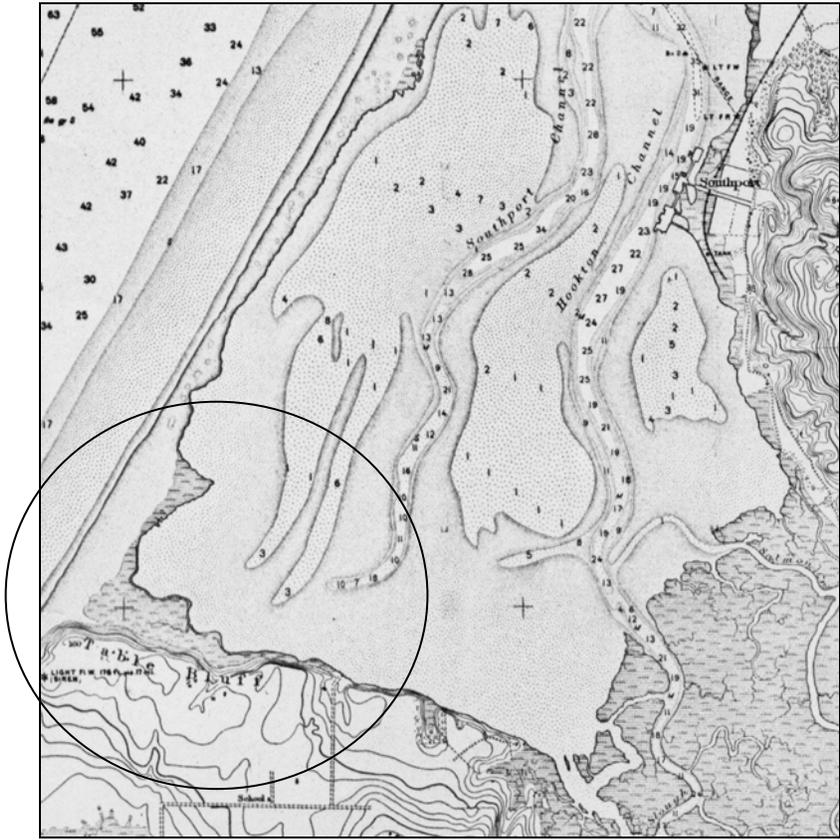
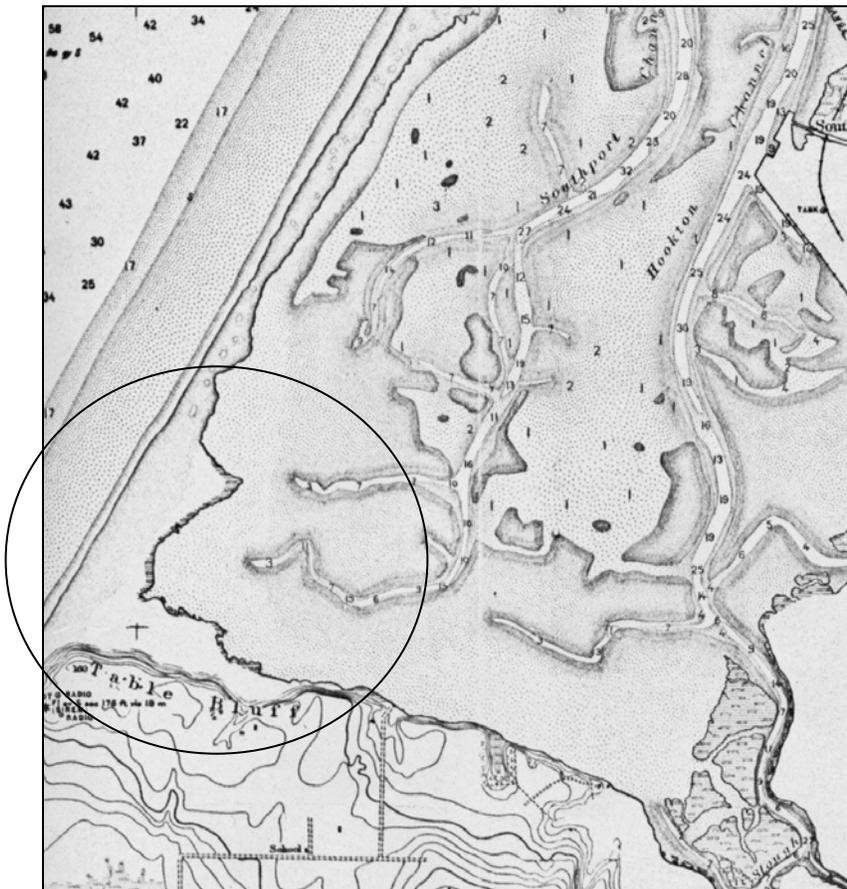


Figure 2. U.S. Coast and Geodetic survey maps from 1913 (above) and 1914 (below) show the diking of the salt marsh at Table Bluff Unit, coincident with the bay-wide diking that accompanied the building of the railroad (maps courtesy Humboldt County Public Works Department).



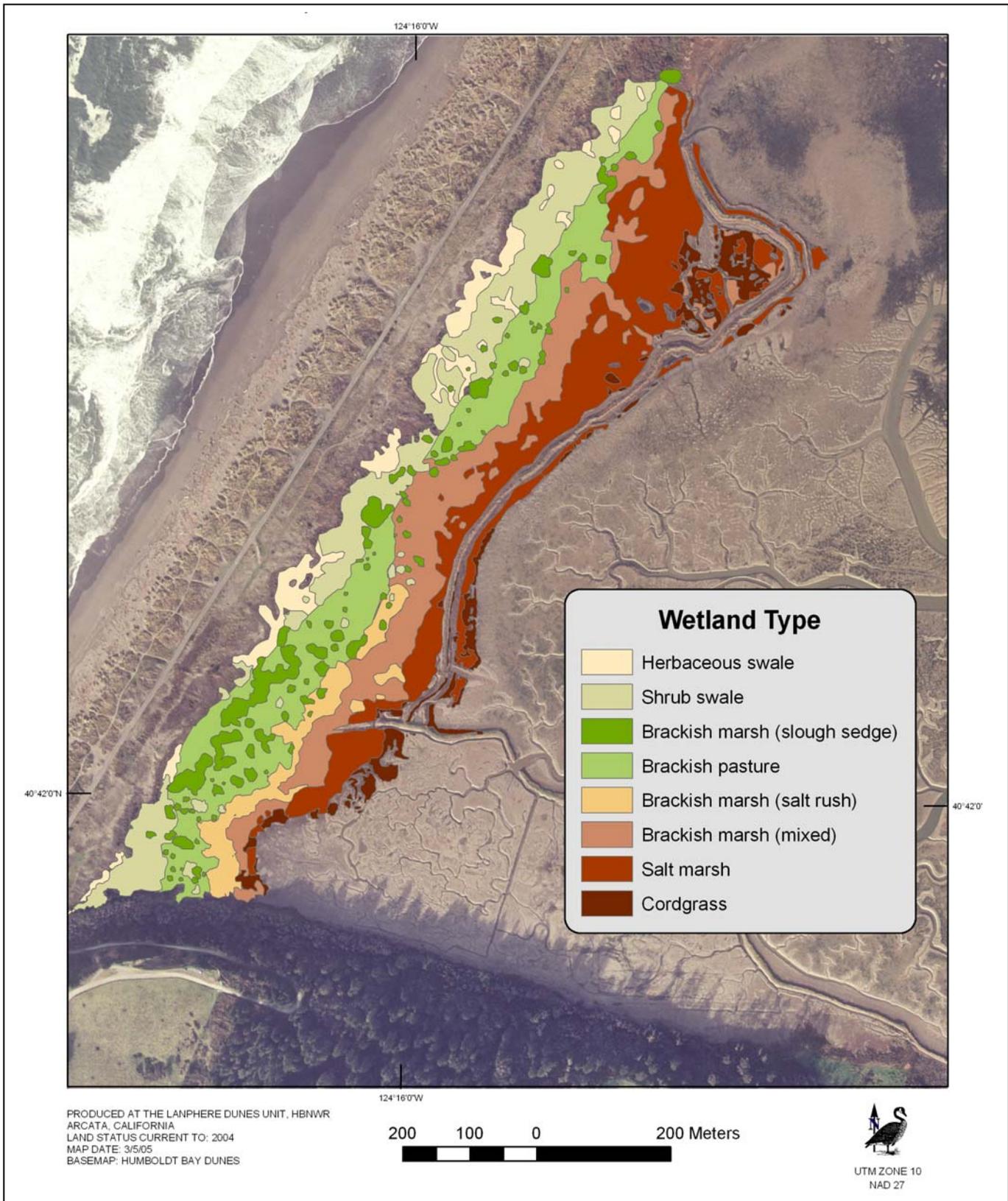


Figure 3. Wetland vegetation types of the Table Bluff Unit.

Cordgrass

The Cordgrass vegetation type consists of up to 100% cover of *Spartina densiflora*, an invasive South American cordgrass, with up to 50% cover of salt grass (*Distichlis spicata*) and/or pickleweed (*Salicornia virginica*) and minor jaumea (*Jaumea carnosa*). Cordgrass appears to be encroaching both into the mudflat and into the salt marsh.

Salt marsh

Salt marsh on the Unit is characterized by 100% cover, comprised of *Distichlis* (25-50%), *Salicornia* (25-50%), *Jaumea* (5-25%), and minor Lyngby's sedge (*Carex lyngbyei*), salt rush (*Juncus leseurii*), sand-spurrey (*Spergularia macrotheca*), and arrow-grass (*Triglochin maritimum*). This vegetation falls within the "mixed marsh" type described by Eicher (1987), characteristic of high elevation marshes.

Brackish marsh

1. Mixed. This subtype is of high cover (100%), dominated by *Juncus leseurii*, but with a mix of saline and brackish associates including spear-scale (*Atriplex triangularis*), *Distichlis spicata*, *Salicornia virginica*, Pacific silverweed (*Potentilla anserina*), seacoast bulrush (*Scirpus maritimus*), and *Triglochin maritimum*.
2. Salt rush. This subtype is distinguished by being composed of 95-100% *Juncus leseurii*, with occasional seawatch angelica (*Angelica lucida*), *Atriplex triangularis*, velvet grass (*Holcus lanatus*), and *Potentilla anserina*, all contributing very minor cover.
3. Slough sedge. The slough sedge subtype is more influenced by freshwater than the other two, and is dominated by sloughs sedge (*Carex obnupta*) (usually over 75%), often occurring as discrete clones. Associated species include water parsley (*Oenanthe sarmentosa*) (5-25%) and California blackberry (*Rubus ursinus*) (5-25%) with *Angelica lucida*, bull thistle (*Cirsium vulgare*), New Zealand fireweed (*Erechtites glomerata*), and cow parsnip (*Heracleum lanatum*), all at cover values of less than 5%.

Brackish pasture

The Brackish Pasture type appears to be in transition from pasture species to Brackish marsh (slough sedge) and/or herbaceous swale. Species composition is variable, with co-dominant dune rush (*Juncus breweri*), *Holcus lanatus*, tall fescue (*Festuca arundinacea*), *Cirsium vulgare*, *Erechtites glomerata*, *Carex obnupta*, sow thistle (*Sonchus oleraceus*), and minor *Potentilla anserina*, hedge nettle (*Stachys ajugoides*), and starwort (*Stellaria calycantha*). Total cover is 100%. With the exception of the Cordgrass type, this vegetation type had the worst invasive species problem, posed by the unchecked spread of *Cirsium* and *Erechtites*.

Herbaceous swale

Herbaceous swales are seasonally flooded, freshwater dune wetlands. Herbaceous swales are largely dominated by *Juncus breweri* (up to 95%), and included minor (<5%) cover of a number of other species including *Stellaria calycantha*, sheep sorrel (*Rumex*

acetosella), English plantain (*Plantago lanceolata*), cudweed (*Gnaphalium stramineum*), *Carex obnupta*, and European harigrass (*Aira praecox* and *A. caryophyllea*). Total cover ranges from approximately 80-100%.

Shrub swale

Shrub swale is a seasonally flooded dune wetland type with variable shrub species composition, depending on the extent of flooding. Swales receiving regular seasonal surface flooding support mostly Hooker's willow (*Salix hookeriana*) or *Rubus ursinus*. Those saturated (by a high water table) but not receiving regular surface flooding may additionally support coyote brush (*Baccharis pilularis*) and bush lupine (*Lupinus arboreus*). The shrubby lupines present on site appear to be mostly hybrids between the non-native *Lupinus arboreus* and the native *Lupinus rivularis*. At the base of the bluff, this type is succeeding to forest, with young Sitka spruce (*Picea sitchensis*) and understory shrubs such as cascara (*Rhamnus purshiana*) and twinberry (*Lonicera involucrata*).

Rare Plants

The 2004 survey did not detect either of the two rare salt marsh species, Humboldt Bay owl's clover or Point Reyes birds-beak. Both species were present to the north on undiked salt marshes (Fig. 12). Their absence at the Table Bluff site could be due to habitat differences resulting from past diking, or restricted dispersal due to the non-contiguous nature of undisturbed salt marshes. More research is needed to address this question. Seeds could be dispersed on site (collected from adjacent sites) to determine whether plants can grow on the site. However, such an effort should not be undertaken without appropriate planning and monitoring.

Invasive Species

Other than the *Spartina densiflora* invasion mentioned above, the only vegetation type to harbor significant invasive plant species is the brackish pasture. The two most invasive species present are bull thistle (*Cirsium vulgare*) and New Zealand fireweed (*Erechtites glomerata*). Both of these are disturbance-stimulated invasives and are probably responding to the changing nature of the vegetation. There are also abundant pasture grasses that are considered invasive in a natural system, including *Holcus lanatus* and *Festuca arundinacea*. If the brackish marsh continues to expand, these species could be outcompeted.



Figure 4. Cordgrass type.



Figure 5. Salt marsh type.



Figure 6. Brackish marsh type (mixed).



Figure 7. Brackish marsh type (salt rush).



Figure 8. Brackish marsh type (slough sedge).



Figure 9. Brackish pasture type



Figure 10. Herbaceous swale type (foreground).



Figure 11. Shrub swale type.



Fig. 12. *Castilleja ambigua* ssp. *humboldtiensis* in the high marsh of the South Spit, just north of the Table Bluff Unit.

DISCUSSION

The Table Bluff Unit includes a suite of habitats in a configuration that is unique to Humboldt Bay. Although the vegetation present prior to EuroAmerican settlement was greatly altered in the past century, the vegetation that exists today is in a relatively pristine condition. The well-defined zonation of vegetation in response to the freshwater (spit) to saltwater (bay) continuum is not as well developed on other parts of the South Spit. Most likely, the presence of the adjacent Table Bluff provides abundant freshwater runoff that recharges the freshwater lens overlying the salt water table at this spot. In addition, the influence of bluff vegetation exists here but less so to the north, either due to greater ease of dispersal, different habitat conditions, or a combination.

The vegetation of the site is in a state of flux, responding to the breach of the dikes in the 1980s, and removal of grazing (Figs.13-17). Grazing may have ceased on the site prior to its sale to HBNWR. Any analysis of change is greatly hampered by the lack of pre-diking data. The large expanse of mudflat (representing 40% of the total site) present on the southeast arm of the Unit resulted from compaction/subsidence during the period it was diked. It appears from 1970s photographs that this portion of the site was already subject to seasonal surface flooding and/or irregular tidal inundation due to faulty tide gates. Vegetation in this portion appears different from that on the north-eastern arm, and may have been brackish or saline in nature. The north-eastern arm, due to its association with the spit, retained elevations high enough to support wetland vegetation types. The presence of sand lenses in the mud due to overwash and historic tsunamis may have contributed to the

lack of apparent subsidence at this site. High elevation salt marsh has developed along the western portion, although further study is needed to determine whether species composition is comparable to adjacent, undiked salt marsh to the north (bearing in mind that freshwater input could have resulted in a difference historically between the salt marsh close to the bluff and that further north). The 1970s photos show that some zonation of vegetation had already begun to develop in the western portion of this arm, although the higher elevations are clearly vegetated with pasture grasses.

The present-day high elevation marshes have been invaded at their western edge by *Spartina densiflora*, but to a far lesser degree than elsewhere in the Bay. A 1999 inventory of *Spartina* in Humboldt bay indicated that 55% of salt marshes were infested with *Spartina* cover between 5 and 69%, and 94% with cover between 5 and 100% (Pickart 2001). Mapping in this project did not attempt to use cover classes, however, the percent of salt marsh at Table Bluff Unit invaded by *Spartina* (20%) falls far short of the bay-wide average whether including the lower cover class or not. Another anomaly of the site is the absence of rare salt marsh annuals, which are present on the South Spit salt marshes to the north. Additional research can ascertain whether differences in habitat characteristics exist and whether the Table Bluff Unit salt marsh is a suitable re-introduction site.

The large band of brackish marsh present between salt marsh and the palustrine dune wetlands to the west is a function of environmental gradients, including elevation, soil moisture, and soil salinity. The easternmost (and presumably lowest elevation and highest salinity) portion is characterized by a transitional vegetation type (termed “mixed” that has elements of both salt and brackish systems. It probably receives irregular tidal inundation and is therefore classified as an estuarine wetland (a topographic map of the site would provide the exact area of tidal influence). At the south end, a subtype of brackish marsh was delineated based on its distinctive species composition of almost pure *Juncus leseurii*, which is also a component of the mixed brackish marsh type. Again, this may be in response to freshwater runoff from the bluff. The westernmost band of brackish vegetation is palustrine in nature, and consists of discrete patches of brackish marsh (slough sedge) in a matrix of what has been termed “brackish pasture.” This portion of the site appears to still be in flux. Remnant pasture grasses mix with brackish and freshwater marsh species, including the monospecific stands of *Carex obnupta*. It appears that *Carex* stands are increasing in this area. Although the 1974 and 76 photos show incipient development of zonation within the pasture, the pattern is much more distinct in the 1987 photos. Determining to what extent the vegetation changes have resulted from the removal of grazing pressure relative to the restoration of tidal inundation requires further study. The fence line and therefore grazing pattern would have influenced vegetation, but the fence was likely placed at the dune/wetland boundary that previously existed. Wetlands west of the fence are largely dune swales, which would have been vegetated with unpalatable species such as *Juncus breweri*.

Herbaceous and shrub swales to the north and west tend to be very similar to those on other parts of the North and South spits. However, at the SE corner of the site, the presence of the nearby bluff has a major influence on these wetlands. In addition to hybrid lupines that are the result of introduced *Lupinus arboreus* crossing with *Lupinus rivularis* native to the coastal scrub habitat on the Bluff, there is also more *Baccharis pilularis* (also a coastal scrub species). Towards the base of the bluff the vegetation approaches freshwater swamp, with Sitka spruce (*Picea sitchensis*) and forest understory shrubs such as *Lonicera involucrata*, and *Rhamnus purshiana*.



Figure 13. 1972 air photo, pre-breaching (photo © 2002-2005 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org)



Figure 14. 1976 air photo, pre-breaching (photo by D. Tuttle, courtesy Humboldt County Public Works department).



Figure 15. 1987 air photo, 3 years post-breaching (photo © 2002-2005 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org)



Figure 16. 1987 air photo, 3 years post-breaching (photo courtesy Humboldt County Public Works Department)



Figure 17. 2000 air photo, 16 years post-breaching, eastern arm is mudflat and northern arm has distinct zonation (photo: US Fish and Wildlife Service).

CONCLUSIONS AND RECOMMENDATIONS

The Table Bluff Unit has unique wetland vegetation composition and patterns for Humboldt Bay, resulting from its history of dike placement and subsequent breaching. The gradient of salt to freshwater is very well illustrated across the northern arm of the Unit, from palustrine dune wetlands on the west to estuarine salt marsh on the east. Other former diked pastures that have been restored to tidal inundation, such as Park Street Marsh and Second Slough do not have the elevation gradient or sandy substrate that the presence of the adjacent South Spit confers on this site. The presence of the Little Salmon Creek fault, responsible for the juxtaposition of the bluff and dune/estuary habitats also contributes to the uniqueness of the site.

The south-eastern arm of the site is primarily mudflat that has formed as the result of subsidence of former salt marsh soils during the period they were diked from 1915 through 1981. The mudflat is apparently too high to support eelgrass and too low to support salt marsh. However, *Spartina densiflora* appears to be spreading to the east and may be capable of eventually colonizing some of this mudflat. Further studies are recommended to determine values of the mudflat such as invertebrate communities and bird use.

The north-western arm of the site contains a highly diverse assemblage of wetlands ranging from seasonally flooded palustrine marsh to regularly flooded estuarine salt marsh. Further research is recommended to determine habitat values and use of the area by birds and mammals. A more comprehensive vegetation study is needed to create a more justified, quantitative vegetation classification. Sampling of species composition could be combined with sampling of soil salinity, moisture, and elevation, allowing for ordination of vegetation data along these gradients. A topographic map would furnish elevations as well as providing an excellent base map for future planning. Further research is recommended to compare the salt marsh habitat found here with that found further north on the South Spit, to determine whether the habitat is suitable for rare salt marsh species, and whether impaired tidal circulation exists and its possible positive or negative ramifications on vegetation, rare plants, and mud flat flora and fauna.

Immediate management is called for in the form of control of the three most invasive plant species: *Spartina densiflora* in the salt marsh, and *Cirsium vulgare* and *Erechtites glomerata* in the brackish pasture. Refer to the Invasives Weed Mapping Project Report for HBNWR (Clifford and Walter 2005) for further information.

Enhanced public access may eventually be considered for this site through the Comprehensive Conservation Planning process. Based on the field visits made for this study, it appears that the site is not particularly conducive to public use. The dense vegetation and frequent flooding would require fairly aggressive trail or boardwalk construction. At present, one of the most attractive and unique qualities of the site is its inaccessibility. Since there are ample nearby sites that the public can attain easy access to (South Spit and the Hookton Slough Unit), Table Bluff would appropriately be left in a relatively inaccessible state. Further studies of animal and bird use may support this management direction.

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